Challenge and hindrance IS use stressors and appraisals: Explaining contrarian associations in post-acceptance IS use behavior

Abstract

Post-acceptance IS use is the key to leveraging value from IS investments. However, it also poses many demands on the user. Drawing on the challenge-hindrance stressor framework, this study develops a theory to explain how and why IS use stressors influence post-acceptance use. We identify two different types of IS use stressors: challenge IS use stressors and hindrance IS use stressors. We hypothesize that they are appraised through challenge IS use appraisal and hindrance IS use appraisal respectively, through which they influence routine use and innovative use. We evaluate our hypotheses by surveying 178 users working in one organization and analyze the data collected using consistent partial least square (PLSc). We find that challenge IS use stressors positively influence routine use and innovative use via challenge IS use appraisal. Hindrance IS use stressors negatively influence routine use via hindrance IS use appraisal. We then dive deeper into these findings using a two-step fuzzy set qualitative comparative analysis (fsQCA), identifying the presence of challenge IS use stressors and challenge IS use appraisal as necessary conditions for high innovative use. We also reveal that the presence of hindrance IS use stressors and hindrance IS use appraisal only influences routine use and innovative use in the absence of challenge IS use stressors and challenge IS use appraisal. We discuss the practical relevance and transferability of our findings based on a comprehensive applicability check. Our findings advance IS scholarship of IS use stress and post-acceptance use by showing how routine use and innovative use emanate from IS use stressors.

Keywords: routine use, innovative use, challenge IS use stressors, hindrance IS use stressors, technostress, appraisal, mixed-methods, fuzzy set qualitative comparative analysis (fsQCA), two-step QCA, applicability check

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Introduction

The ongoing and everyday post-acceptance use of implemented information systems (IS) by employees is key to leveraging value from IS investments (Jasperson et al. 2005, Li et al. 2013). Literature on workplace IS use shows that IS use can be routine or innovative (Burton-Jones and Grange 2013). Both types can improve a user's performance. Routine use is exploitative in nature. It implies that the IS is used in a predictable and standardized way to accomplish work (Li et al. 2013; Sun et al. 2019). It increases efficiency and reduces susceptibility to errors. Innovative use is when users discover new ways of using an IS to accomplish work in novel ways. It is explorative in nature (Li et al. 2013; Sun et al. 2019), such that users accomplish tasks more creatively and effectively. Thus, organizations benefit from users using IS routinely and innovatively. Both use types are central for organizations to translate IS investments into business value (Devaraj and Kohli 2003). Even though both routine use and innovative use can be beneficial, little is known about when, why, and how they emerge.

Recent research shows that psychological factors relating to individual motivation can explain why some users use IS more routinely or more innovatively than others (Li et al. 2013). A further important finding of research is that users' perceptions of their IS use is shaped by the IS use environment (Jasperson et al. 2005), such as the workplace, through the demands that emerge from it (Eckhardt et al. 2013). Most workplace IS use environments make significant IS use demands on users, including system breakdowns, the need to constantly learn to use new IS and work with IS under time pressure. Users inevitably get confronted with these demands because working without any IS use is almost impossible in most lines of work and IS use has become an integral part of organizational processes and workflows.

Extant research into IS use demands provides two useful concepts on how IS use stressors shape their IS use. First, there is substantial evidence that IS use demands burden the users. Such perceived demands, which we will call *IS use stressors* in the following, are appraised as

negative factors that hinder and adversely affect their IS use and job-related outcomes (Ayyagari et al. 2011; Tarafdar et al. 2020). Second, and diametrically opposed, other studies indicate that users sometimes appraise certain IS use stressors as challenging in a positive way, such that IS use stressors stimulate them to increase their performance by discovering new ways of working by using IS innovatively (Eckhardt et al. 2013).

Both concepts indicate that IS use stressors are connected to users' IS use, either in a hindering or challenging way. In order to provide an understanding of how IS use stressors exactly shape IS use, in terms of the two important use behaviors routine use and innovative use, we draw on the challenge-hindrance stressor framework (LePine et al. 2005), a prominent theoretical framework from organizational behavior literature. Drawing on this framework, we develop theory that links IS use stressors on the one side with routine use and innovative use on the other side. Specifically, we conceptualize two different types of IS use stressors. Challenge IS use stressors reflect IS use demands that present the potential for a user's personal growth, development, reward, or learning, such as working with IS under pressure. Hindrance IS use stressors are IS use demands that present the potential for a user's loss, constraint or harm, such as a system breakdown. We examine how users perceive and appraise the challenge IS use stressors and hindrance IS use stressors and how both types of IS use stressors and their appraisal influence routine use and innovative use of IS, as formulated in our research question:

> *How do challenge IS use stressors and hindrance IS use stressors influence routine use and innovative use?*

Based on the challenge-hindrance stressor framework (LePine et al. 2005) we conceptualize and define four new constructs. We argue that the influence on routine use and innovative use depends on how challenge IS use stressors and hindrance IS use stressors are appraised when they are perceived (Lazarus and Folkman 1984; LePine et al. 2016). Thereby, challenge IS

use appraisal refers to a user's subjective interpretation that IS use demands have the potential to benefit them in terms of personal growth, development, reward, or learning. In contrast, hindrance IS use appraisal refers to a user's subjective interpretation that IS use demands have the potential to affect them adversely in terms of loss, constraint or harm. We draw on these two separate appraisal processes to develop our research hypotheses, suggesting that the interplay between challenge IS use stressors and hindrance IS use stressors respectively appraisal influences routine use and innovative use.

Our methodological approach is to evaluate our research hypotheses based on data collected in a single organization (N=178) taking a structural equation modelling (SEM) approach. Employing the consistent PLS (PLSc) method, we found empirical support for three out of four hypotheses. Our findings suggest that challenge IS use stressors have a positive influence on routine use and innovative use via challenge IS use appraisal. Our analysis also indicates that hindrance IS use stressors have a negative effect on routine use via hindrance IS use appraisal. However, we do not find statistical evidence that hindrance IS use stressors influence innovative use via hindrance IS use appraisal.

To better understand the non-significant relationship between hindrance IS use appraisal and innovative use, we perform a post-hoc analysis to expand our results and complement the variable-focused SEM method with a case-focused method in terms of a two-step fuzzy set qualitative comparative analysis (fsQCA). This allows us to complement the symmetric test (through SEM) with an asymmetric test (through fsQCA). Symmetric tests study the accuracy in high values of an antecedent condition indicating high/low[1] values of an outcome condition

[1] In symmetric tests, there are two possible relationships: A positive relationship means that high values of an antecedent condition indicate high values of an outcome condition and low values of an antecedent condition indicate low values of an outcome condition. A negative relationship means that low values of an antecedent condition indicate high values of an outcome condition and high values of an antecedent condition indicate low values of an outcome condition. Symmetric tests study the accuracy of a specific value of an antecedent condition indicating a specific value of an outcome condition by always studying

and low values of the antecedent condition indicating low/high[1] values of the outcome condition. In contrast, asymmetric tests[2] study the accuracy of a specific value (i.e. high or low) of an antecedent condition, indicating a specific value (i.e. high or low) of an outcome condition, without predicting how the inverse of the value of the antecedent condition relates to values of the outcome condition. Thus, asymmetric tests, such as fsQCA, are a way to analyze contrarian associations. It is assumed that even for large effect sizes, 10 to 20 percent of the cases in a data set display contrarian associations (Spivack and Woodside 2019). Given that the SEM method did not identify a symmetric association between hindrance IS use appraisal and innovative use, this percentage of contrarian associations was likely to be even higher and hence an explanation for the non-significance. To analyze this, we investigate configurations of antecedent conditions which contributes to innovative use. Further, for the sake of a holistic analysis, we also do the same for routine use. Results of the two-step fsQCA confirm the existence of contrarian associations in the following two aspects. The first is causal asymmetry, meaning that different and not inverse antecedent conditions contribute to high routine or high innovative use than those antecedent conditions contributing to low routine or low innovative use. The second is causal complexity, meaning that, on the one hand, more than one antecedent condition contributes to routine use and innovative use and that, on the other hand, a mixture of presence or absence of challenge IS use stressors and hindrance IS use stressors - via the mediating impact of challenge IS use appraisal and hindrance IS use appraisal - contributes to whether users engage in high or low routine use and innovative use. These insights resulting from cases in the data set that follow contrarian

whether the inverse of the value of the antecedent condition also relates to the inverse value of the outcome condition.

[2] In asymmetric tests, one can study 1) high values of antecedent condition indicating high values of an outcome condition, 2) high values of antecedent condition indicating low values of an outcome condition, 3) low values of antecedent condition indicating high values of an outcome condition, 4) low values of antecedent condition indicating low values of an outcome condition, whereby in all four cases it is not studied by asymmetric tests how the inverse value of the antecedent condition indicates the value of the outcome condition.

associations gave us richer theoretical insights into how challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal, and hindrance IS use appraisal contribute to routine use and innovative use. In a final methodological step, we assess the practical value of our findings by conducting an applicability check (Rosemann and Vessey 2008) of our results in post-survey interviews.

Our first contribution is to offer a theoretical and empirical understanding of how routine use and innovative use emerge from the user's appraisal of IS use stressors in their IS use environment. We conceptually extend the literature considering internal motivational factors as antecedents of routine use and innovative use by showing that demands appraised in the external environment shape these use behaviors. Second, we extend IS use stress research by conceptualizing two different types of IS use stressors (challenge IS use stressors and hindrance IS use stressors) and appraisals (challenge IS use appraisal and hindrance IS use appraisal) and empirically validate their linkages. Overall, by integrating IS use stress and post-acceptance use research, we offer a novel theoretical perspective on how users respond to ongoing IS use demands. Finally, we contribute by using an innovative methodological approach that integrates SEM analysis with a two-step fsQCA analysis to reveal contrarian association, followed by an applicability check.

The remainder of this paper is structured as follows. After reviewing the research discussing post-acceptance IS use behavior and IS use stress research, we explain the challenge-hindrance stressor framework that guides our theorization. Based on that, we conceptualize the new constructs, which are then used to develop our research model and evaluate it with quantitative survey data applying SEM. To complement our results with post-hoc analyses, we then perform a two-step fsQCA to also consider cases in the data set that follow a contrarian association. Then, an applicability check demonstrates that our results are valuable

for and applicable to managerial practice. Finally, we outline our contributions and recommend potential areas of future research.

Literature review on post-acceptance IS use and IS use stress

Our study explains the influences of different IS use demands on routine use and innovative use. The literature review situates it at the intersection of the research strands of post-acceptance IS use and IS use stress research.

Post-acceptance IS use

The large body of research on post-acceptance IS use (Burton-Jones et al. 2017) reveals insights into antecedent factors of post-acceptance IS use (Bhattacherjee 2001; Bhattacherjee and Lin 2014; Jasperson et al. 2005; Thatcher et al. 2018). However, research on specific post-acceptance IS use behaviors remains scant (Carter et al. 2012). Broadly, research posits that there are two central types of post-acceptance IS use behaviors: routine use and innovative use (Table 1).

Construct	Definition (Li et al. 2013, p. 659)
Routine use	"using IS in a routine and standardized manner to support their work"
Innovative use	"discovering new ways to use IS to support their work"

Table 1: Definition of routine use and innovative use

Routine use is defined as a standardized way of utilizing IS to support one's work. It is characterized as exploitative use with a large degree of routinization (Li et al. 2013; Roberts et al. 2016). To a large extent, routine use reflects that the use of IS is considered a normal part of everyday work (Saga and Zmud 1994; Sundaram et al. 2007). One implication of routine use of an IS is that fewer variations can be observed in the user's use patterns (Saga and Zmud 1994). Its exploitative characterization is reflected in the notion that the IS is used in a standardized and predictable way, and users become more efficient at appropriating benefits from it (Sun et al. 2019).

Innovative use is when a user discovers new ways of working with IS to support their work. It is characterized as explorative, emergent and extended use (Li et al. 2013; Roberts et al.

2016). To a large extent, innovative use indicates that a user tries to innovate by discovering new ways of using IS (Ahuja and Thatcher 2005; Jasperson et al. 2005; Sundaram et al. 2007). Innovative users have a high willingness to apply the IS in new ways and areas (Nambisan et al. 1999) to achieve results not feasible without such use (Nambisan et al. 1999; Saga and Zmud 1994). Innovative use is explorative when users actively attempt to experiment in their use of IS in order to do their work (Sun et al. 2019). Routine use usually precedes innovative use but both can occur simultaneously (Li et al. 2013).

It is widely acknowledged that IS use is key to transforming IS investments into business value (Devaraj and Kohli 2003). Thus, both routine use and innovative use are crucial for organizations. Indeed, research shows that both positively influence task productivity, task innovation and management control, thus enhancing users' task performance (Sun et al. 2019). Both are also associated with the volume and diversity of managers' ideas for organizational innovation (Roberts et al. 2016).

Extant research on the antecedents of routine use and innovative use has focused primarily on motivation. Research distinguishes between extrinsic motivational factors, such as perceived usefulness, and intrinsic motivational factors, such as the intrinsic motivation to know, accomplish or experience stimulation. Both sets of factors drive routine usage, while only intrinsic motivational factors drive innovative use (Li et al. 2013). For routine use, the relative effect of extrinsic motivation has been shown to be greater than the relative effect of intrinsic motivation, and the reverse holds true for innovative use (Li et al. 2013).

In parallel, an emerging research strand also considers the potential effects of IS use environments and the emerging IS use demands on IS use (Ahuja and Thatcher 2005; Maier et al. 2015b; Tarafdar et al. 2020). The notion pervading this strand is that IS use is influenced by IS use stressors. In the workplace environment, for example, too much work demands burden the user, which might inhibit them from being innovative in IT. While there is some

research on factors inhibiting IS use in general (Cenfetelli 2004; Cenfetelli and Schwarz 2011), to date, little is understood about how IS use demands are related to routine use and innovative use. The literature on IS use demands focuses on stress relating to the use of IT in organizations, to which we turn next.

IS use stress

The majority of research on IS use stress relies on the transactional model of stress (Lazarus and Folkman 1984) to describe the overall stress process relating to IS use, including causes and consequences (Ayyagari et al. 2011; Tarafdar et al. 2019). Specifically, research has focused on five IS use stressors (Ragu-Nathan et al. 2008; Tarafdar et al. 2010): techno-invasion, techno-complexity, techno-overload, techno-insecurity and techno-uncertainty. Other research approaches indicate that technological characteristics within the workplace environment might cause IS use stressors, including job insecurity, role ambiguity, work-home conflict, invasion of privacy or work overload (Ayyagari et al. 2011; Maier et al. 2015a) or that that there is a close correlation between personality traits and stress from IS use (Pflügner et al. 2020a; Pflügner et al. 2020b).

IS research further informs us that IS use stressors evoke behavioral outcomes (Ragu-Nathan et al. 2008; Tarafdar et al. 2010; Tarafdar et al. 2015). Among others, it has been shown that IS use stressors can lead to quitting the job, lower user performance and less innovativeness (Maier et al. 2015a; Maier et al. 2019; Ragu-Nathan et al. 2008). We also see that users adapt their IS use behavior in stressful situations (Maier et al. 2015b; Tarafdar et al. 2020). Indeed, emerging concepts show that IS use stressors that are perceived as positive by the user are not expected to lead to negative outcomes (Tarafdar et al. 2019). Thus, there are research opportunities to understand how IS use stressors and IS use appraisal can together shape post-acceptance IS use in terms of routine use and innovative use.

Summary and research objective

Our review of the literature implies several things. First, post-acceptance IS use research has noted the importance of routine use and innovative use. It has examined its motivational antecedents and indicates that IS use environments and the emerging demands can shape IS use. Second, research on IS use stress has focused on demands that burden the user and create stress, labeled as IS use stressors. However, it has focused more on IS use stressors that hinder users and lead to negative effects (Ayyagari et al. 2011; Ragu-Nathan et al. 2008) than on the potentially positive challenging influence of IS use stressors on IS use. Our research objective extends these two literature streams by studying how the perception of IS use demands appraised in the IS use environment can influence routine use and innovative use. Thereby, we examine IS use demands that are perceived and then negatively appraised hinder and positively appraised challenge the user.

Theoretical background: Challenge-hindrance stressor framework

The challenge-hindrance stressor framework from the organizational behavior literature (Cavanaugh et al. 2000; LePine et al. 2005) is a theoretical lens that explains individuals' behavior in response to stressors and their appraisal processes. The stressor represents the perception of the presence of the demand and it is suggested that a given stressor is either a challenge or a hindrance stressor (LePine et al. 2016). *Challenge stressors* are the demands that present the potential for personal growth and rewards. *Hindrance stressors* are the demands that present the potential for personal loss, constraint or harm. The appraisal is then the subjective evaluation of the meaning of the demanding stimulus (LePine et al. 2016). Challenge appraisal means that the demands are appraised to be beneficial for the individual, e.g. in terms of personal growth. Hindrance appraisal means that the demands are appraised to be adverse for the individual, e.g. in terms of personal loss. With two types of stressors and appraisals, the challenge-hindrance framework proposes that each type of stressor is appraised

separately, whereby challenge stressors are generally appraised as challenging and hindrance stressors as hindering (Cavanaugh et al. 2000; LePine et al. 2005).

With that understanding, the challenge-hindrance stressor framework argues that challenge and hindrance stressors influence behavior if they are appraised. That is, both the type of the stressor (Selye 1984; Selye 1993) and the corresponding appraisal of the stressor (Lazarus and Folkman 1984) together have positive or negative effects on individuals (LePine et al. 2016) in terms of emotions, psychological states or behavior (Ohly and Fritz 2010; Webster et al. 2011). This implies that the positive influence of challenge stressors on behavior is only realized if they are also appraised as positive, that is, as providing an opportunity. Likewise, the negative influence of hindrance stressors on behavior is only realized if they are also appraised as hindering, that is, providing a threat. Among others, we see that hindrance appraisals result in emotional exhaustion, job dissatisfaction or turnover intention (Webster et al. 2011), while challenge appraisals increase creativity or lead the individual to behave proactively (Ohly and Fritz 2010).

Conceptualization of challenge and hindrance IS use stressors and appraisals

In the context of IS use as examined behavior, we draw from the challenge-hindrance stressor framework (Cavanaugh et al. 2000; Crawford et al. 2010; LePine et al. 2005) to distinguish between and to define challenge IS use stressors and challenge IS use appraisal as well as hindrance IS use stressors and hindrance IS use appraisal, as shown in Table 2.

Challenge IS use stressors	**Definition**
	IS use demands that present the potential for a user's personal growth, development, reward, or learning.
	Examples
	• Completing a lot of work with IS, • Tight time schedules, • Performing complex tasks, • Many IS-related responsibilities.
Hindrance IS use stressors	**Definition**
	IS use demands that present the potential for a user's loss, constraint or harm.
	Examples
	• System breakdown or computer freeze, • Software updates, • Missing or unclear features, • System delays, • Conflicts and disputes with others about IS use.
Challenge IS use appraisal	**Definition**
	A user's subjective interpretation that IS use demands have the potential to benefit them in terms of personal growth, development, reward, or learning.
Hindrance IS use appraisal	**Definition**
	A user's subjective interpretation that IS use demands have the potential to affect them adversely in terms of personal loss, constraint or harm.

Table 2: Definition of challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal, and hindrance IS use appraisal

Two types of IS use stressors. Based on the related management literature and conceptual IS research (Tarafdar et al. 2019), we suggest that there are two types of stressors in the IS use context in terms of challenge IS use stressors and hindrance IS use stressors.

We define challenge IS use stressors as IS use demands that present the potential for a user's personal growth, development, reward, or learning. Such challenge IS use stressors include, among others, having high levels of responsibility that involve IS use, having a high workload that requires IS use, or having to perform complex tasks through IS (Eckhardt et al. 2013). These stressors have the potential to result in positive outcomes for the user as the stressor is the perception of the presence of the demand. However, it still needs to be subjectively interpreted before it has the influence on the outcome.

In contrast to that, hindrance IS use stressors refer to IS use demands that present the potential for a user's loss, constraint, or harm. Among others, it has been shown that computer freezes (Weinert et al. 2020), security issues (D'Arcy et al. 2014) or intrusive IS (Ayyagari et al. 2011) are hindrance IS use stressors in everyday work. These stressors have then the potential to result in negative outcomes for the user.

Two associated appraisals of IS use stressors.[3] We conceptualize that there are two types of IS use appraisal.

Challenge IS use appraisal refers to a user's subjective interpretation that IS use demands have the potential to benefit them in terms of personal growth, development, reward, or learning (Tarafdar et al 2019). This means that even though dealing with such a demand requires time and effort, the user expects it to be beneficial and rewarding. So, the appraisal is grounded in the evaluation of the IS use demand in the IS use environment (Jasperson et al. 2005). Among others, working with IS under pressure might be evaluated by the user as opportunity to find new ways of performing the task, to let them expect appreciation, to save time when doing the task in a new and better way in the future or just to do their work faster (Eckhardt et al. 2013).

In contrast, hindrance IS use appraisal refers to a user's subjective interpretation that IS use demands have the potential to affect them adversely in terms of loss, constraint or harm. This means that dealing with the stressors in the IS use environment (Jasperson et al. 2005) is

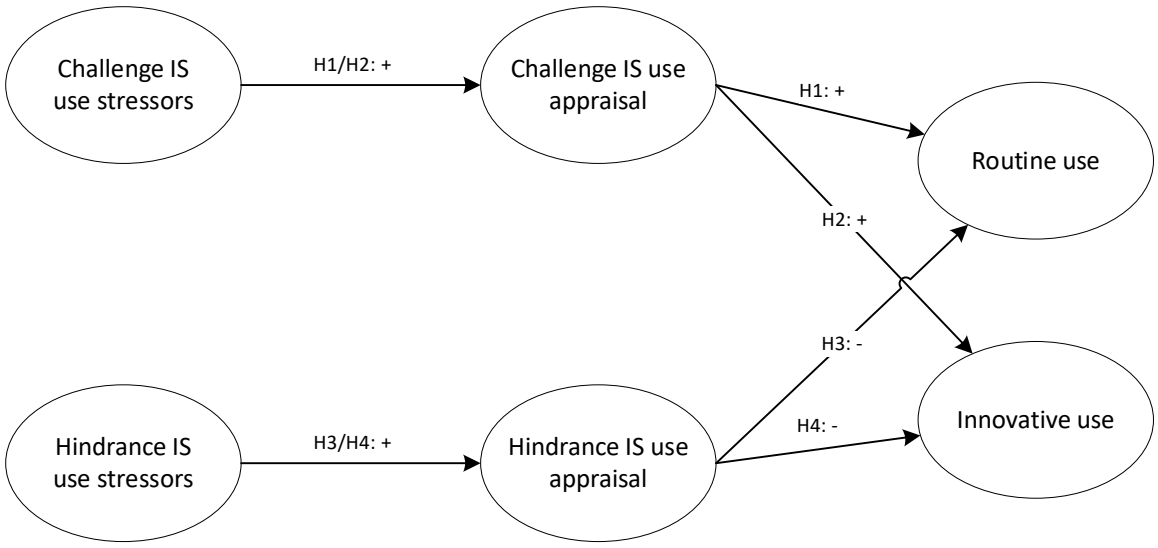
[3] Comparing the terms used by LePine et al. (2016) and Tarafdar et al. (2019a), we note that both agree that the stressor is the perception of the demand. Among others, Tarafdar et al (2019a) lay out the process that considers the primary appraisal of the demand leading to the stressor. LePine et al. (2016) and Tarafdar et al. (2019a) also agree that the subsequent mediator between the stressor and the outcome explains how the user responds to the stressor and engages in behavioral actions (in our case routine use and innovative use). Lepine et al. (2016) refer to the response as 'challenge appraisal' or 'hindrance appraisal', while Tarafdar et al (2019a) call it a challenge coping response and threat coping response, subsequent to a secondary appraisal. In this paper we want to stay close to the underlying theory of our research and therefore adopt the terms provided by LePine et al. (2016).

interpreted as requiring time and effort that will not be rewarded. Among others, the freeze of a computer costs users time and effort in fixing the issue without doing the intended task (Weinert et al. 2020) and, similar, IS security issues do also only cost time and effort without getting rewards (D'Arcy et al. 2014) so that the user typically evaluates fixing the computer freeze or fixing IS security issues as hindering.

Summary. Based on these definitions, we see that both types of stressors stem from IS use demands (Tarafdar et al. 2019) in their IS use environment (Jasperson et al. 2005). During the appraisals, a user evaluates the present IS use stressors based on their interpretation of whether the invested time and effort will be rewarded. We next develop our hypotheses explaining how challenge IS use stressors and hindrance IS use stressors mediated by challenge IS use appraisal and hindrance IS use appraisal influence routine use and innovative use.

Hypotheses development

Based on the four newly conceptualized constructs, we next develop four hypotheses (Figure 1).



Note:
H1-H4 are mediating hypotheses.
H1 and H2 indicate positive mediating hypotheses.
H3 and H4 indicate negative mediating hypotheses.

Figure 1: Research model

Challenge IS use stressors and challenge IS use appraisal

Challenge IS use stressors include, among others, a high workload that requires the use of an IS, complexity of tasks that are executed through IS, working with an IS to meet deadlines under time pressure and the necessity of using broad IS-related skills and abilities. To understand how a user reacts to the presence of challenge IS use stressors, we focus on how the user evaluates them in the workplace environment and assesses whether the stressors benefit the user, e.g. by enabling them to get more work done when using IS and therefore being more productive. The presence of challenge IS use stressors is thus evaluated in the broader work context and in terms of whether they provide opportunities for work-related personal development and accomplishments. For example, when a user perceives a high workload that requires the use of an IS, they assess whether this, when done successfully, will provide rewards. We suggest that challenge IS use appraisal is particularly likely when the user has a sense that their time and energy investments will be rewarded in the demanding workplace environment (Crawford et al. 2010; Lazarus and Folkman 1984). We posit that when the presence of a challenge IS use stressor is appraised as such and, thus, evaluated as

opportunity for the user in their workplace environment, it will influence post-acceptance IS use behavior in two ways.

In the first scenario (H1), the user will consider using IS as a normal part of their work (Schweiger and DeNisi 1991) and thus integrate it into their work routine (Laumer et al. 2016; Sundaram et al. 2007). When a challenge IS use stressor is present and the user evaluates that the stressor will be beneficial to them, they tend to use the IS in a routine way (Li et al. 2013). For example, when the user experiences ongoing high workload that requires the use of an IS, they would incorporate the associated use of IS into their work routine, thus engaging in routine use.

In the second scenario (H2), the user may expect to use the IS more innovatively to achieve their work tasks more quickly, efficiently, effectively, and enjoyably (Saga and Zmud 1994), such as by finding new uses for the IS (Ahuja and Thatcher 2005) or by exploring the IS and identifying new benefits of using it (Nambisan et al. 1999). For example, when working with an IS under time pressure, a user might identify innovative ways of using IS to accomplish tasks, such as finding new features that may enable them to quickly accomplish their work (Eckhardt et al. 2013). Hence, based on the presence of the challenge IS use stressor and the evaluation of the stressor as an opportunity, innovative use can occur, such that the IS is used in ways that go beyond the original use intention (Jasperson et al. 2005; Sun 2012). We, therefore, hypothesize that:

> **H1**: Challenge IS use stressors have a positive mediated effect on routine use via challenge IS use appraisal.
>
> **H2**: Challenge IS use stressors have a positive mediated effect on innovative use via challenge IS use appraisal.

Hindrance IS use stressors and hindrance IS use appraisal

Hindrance IS use stressors include daily hassles such as IS breakdowns that make it more difficult or time-consuming to complete one's work, unclear instructions on how to use an IS, or IS that are inadequate for accomplishing tasks (Ayyagari et al. 2011; Riedl et al. 2012; Tarafdar et al. 2010). When the user is confronted with hindrance IS use stressors, they evaluate their potential impact on their work as obstacles that prevent the accomplishment of work tasks, because they require them to invest effort and time in handling them, which distracts them from the regular work tasks. Hence, the IS use stressor is evaluated as having the potential for a negative impact. We theorize that hindrance IS use appraisal is particularly likely when it is not possible, or at least difficult, for the user to estimate whether their investment of time and energy will be rewarded in the demanding work environment (Crawford et al. 2010; Lazarus and Folkman 1984). This can lead to two scenarios.

In the first (H3), the user engages in workarounds to avoid the use of the IS (Ferneley and Sobreperez 2006; Laumer et al. 2017), demonstrating less willingness to integrate the IS associated with the IS use stressor into their routine work (Schwarz et al. 2014). Thus, they are not able to settle into routine use behaviors.

In the second scenario (H4), the user is not motivated to find the time, make the effort, or be interested in exploring new or innovative potential uses of the IS to support their work (Nambisan et al. 1999). Thus, in this scenario, they are then less likely to use the IS in an innovative manner. We, therefore, hypothesize that:

> **H3**: Hindrance IS use stressors have a negative mediated effect on routine use via hindrance IS use appraisal.
>
> **H4**: Hindrance IS use stressors have a negative mediated effect on innovative use via hindrance IS use appraisal.

Methodological approach: quantitative survey study

To test the hypotheses, we adopt a quantitative research approach. We collect survey data from IS users in an organization.

Organizational characteristics and sample characteristics. Our empirical site is an organization that produces drivetrain and brake system applications for the automotive industry. It has more than 3,500 employees and an annual sales volume of around € 500 million. The organization is headquartered in the EU and has factories around the world, including the United States, Germany and China. Employees use general office IS applications for day to day work such as ERP software, Microsoft Office, an email client and also other technologies relevant to IS use stress (Ayyagari et al. 2011).

Demographics (in percent)		
Sex		41% female, 59% male
Age (mean 37.5)	<20	1.8
	20-29	31.2
	30-39	33.9
	40-49	15.6
	50-59	9.6
	>59	7.8
Profession	IS professional	48.6
	other	51.4
Extent of ICT use at work per day (in minutes) (mean 256.6)	< 30	3.5
	30-59	7.0
	60-119	10.4
	120-179	11.4
	180-239	9.5
	240-299	11.4
	300-359	16.4
	360-419	9.5
	> 419	20.9

Table 3: Demographics of the participants (N=178)

We collaborated with the organization's CEO office to select potential participants. The number of invitations was limited by the CEO's office and employees were selected randomly. In total, we invited 200 employees to participate in the survey and 178 employees responded. All of them worked in the same branch. With respect to the data sample (see Table 3), 59 percent were male. The average participant was 37.5 years old and used IS (such as ERP software, Microsoft Office, an email client) 256.6 minutes per day for work purposes.

Measures. In the survey, we measured the relevant constructs including challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal, hindrance IS use appraisal, routine use and innovative use. We also measure four control variables that included intrinsic motivation toward accomplishment, intrinsic motivation to know, intrinsic motivation to experience stimulation, and extrinsic motivation.

As far as possible, our survey items are based on measures validated in previous research (see Appendix A). For challenge IS use stressors and hindrance IS use stressors, we adapted

measures from previous scales based on organizational behavior research (LePine et al. 2016) to develop new scales for both (see Appendix A for more details). Challenge IS use appraisal and hindrance IS use appraisal are measured with three items each, which we adapted to the IS use context from previous research (LePine et al. 2016). Routine use and innovative use are measured both as suggested in previous research (Li et al. 2013) and the same was done for the control variables (i.e. intrinsic motivation toward accomplishment, intrinsic motivation to know, intrinsic motivation to experience stimulation, extrinsic motivation) (Li et al. 2013). While the survey is done in Germany, we follow recommendations of Brislin (1970) and the translation and back-translation procedure to ensure equivalence. This means that we first set the items in English, then carefully translate the items into German by three native speakers. Based on those translations, we discussed differences until we reached a consensus on the items. Finally, a bilingual, English native speaker, who was not involved in the first steps translated the items back. After reworking minor differences, the final formulations are presented in Appendix A.

Results of hypothesis testing

Our empirical analysis adopts the consistent partial least squares path modeling (PLSc) method (Dijkstra and Henseler 2015) and SmartPLS 3.2.7 (Ringle et al. 2014). By adhering to the widely accepted rule of ten as well as suggestions that a given level of power depends on a wide range of different aspects (Kim 2005), our sample size exceeds the requirements of Steiger's gamma (114.7) and RMSEA (101.0) (Appendix B). Moreover, we determine the extent of common method bias (CMB) with four different tests and can conclude that CMB is not an issue for the results (Appendix B).

Measurement model. Each construct is measured by reflective indicators. We validate the measurement model by ensuring content validity, indicator reliability, construct reliability, and discriminant validity (Bagozzi 1979). To ensure content validity, we either adapt items

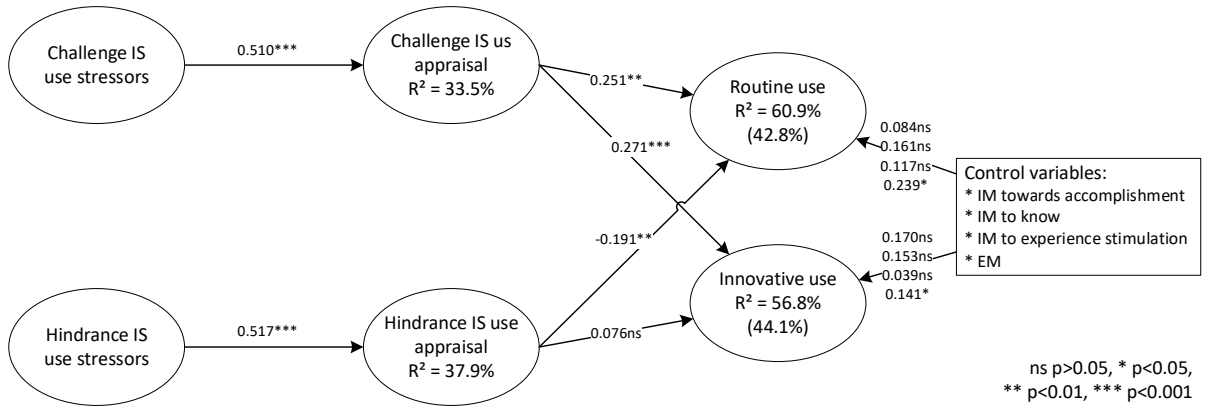
from prior research to the IS use context or develop new items for constructs, which have not been used before (see Appendix A). Indicator reliability indicates the rate of variance of an indicator that has its origins in the latent variables. To explain 50 percent of the variance of a latent variable by the indicators, the factor loading must exceed the recommended threshold of 0.707 (Carmines and Zeller 2008). This is fulfilled for all indicators and the loadings are highly significant (Appendix A), as proven using the bootstrap method. Finally, we perform an exploratory factor analysis (EFA) and a confirmatory factor analysis (CFA). Our findings show that we have six separate constructs: challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal, hindrance IS use appraisal, routine use, and innovative use. We next calculate composite reliability (CR) and average variance extracted (AVE) (Fornell and Larcker 1981), and compare it to the recommended criteria whereby AVE should be higher than 0.5 and CR higher than 0.7. As illustrated in Appendix B, both criteria are fulfilled. Discriminant validity describes the extent to which measurement items differ from each other (Campell and Fiske 1959). As illustrated in the diagonal of the bivariate correlations in Appendix B, these square root values are greater than the corresponding construct correlations (Fornell and Larcker 1981; Hulland 1999), and the requirement is fulfilled. We use the heterotrait-monotrait (HTMT) ratio of correlations criterion to assess discriminant validity because it is considered more reliable than the Fornell-Larcker criterion (Henseler et al. 2014b). Using the absolute $HTMT_{0.85}$ criterion indicates that discriminant validity is not an issue in our research, so the measurement model is valid.

We also test for multicollinearity. As indicated by the variance inflation factor (VIF) indicator, each VIF value is lower than the recommended maximum VIF value of 5 (Rogerson 2001) with the highest value of 2.995 between innovative use and intrinsic motivation to know.

Structural model. We use the coefficient of determination (R^2), the significance levels of each path coefficient, the mediation effects, the effect sizes, and the standardized root mean square residual (SRMR) to evaluate the structural model. As illustrated in Figure 2, the coefficient of determination indicates that we explain 60.9 percent of the variance of routine use and 56.8 percent of the variance of innovative use. Based on path coefficients and significance tests, we identify one path as non-significant. Specifically, our results reveal that challenge IS use stressors significantly influence challenge IS use appraisal and hindrance IS use stressors significantly influence hindrance IS use appraisal. Moreover, challenge IS use appraisal positively influences routine use and innovative use and hindrance IS use appraisal negatively influences routine use. However, our data indicates that hindrance IS use appraisal does not significantly influence innovative use. Moreover, our results reveal that of the control variables, only extrinsic motivation influences routine use and innovative use significantly. To specifically test our mediation hypotheses, we apply a bootstrapping technique, confirming three out of four mediation effects. Specifically, challenge IS use stressors have a positive mediated effect on both routine use (H1 supported; 0.128, $p<0.025$) and innovative use (H2 supported; 0.139, $p<0.005$) via challenge IS use appraisal. Hindrance IS use stressors have a negative mediated effect on routine use (H3 supported; –0.099; $p<0.001$) via hindrance IS use appraisal. However, there is no negative mediated effect of hindrance IS use stressors on innovative use via hindrance IS use appraisal (H4 not supported; 0.040, $p>0.200$). We confirm these results using other approaches (Baron and Kenny 1986; Preacher and Hayes 2004). We also compare the effect sizes of our control variables, which have been studied in previous research as antecedents of routine use and innovative use, with our target variables. The results indicate that only extrinsic motivation has a significant impact on routine use and innovative use.

Our results indicate that the control variables have a weak strength of effect for routine (0.118) and innovative use (0.186), while challenge IS use stressors, hindrance IS use

stressors, challenge IS use appraisal and hindrance IS use appraisal have higher strength of effect for routine (0.463) and innovative use (0.294). Finally, Henseler et al. (2014a) propose using the *SRMR*. With a value of 0.06 and hence far less than the recommended maximum value of 0.10 or 0.08 (Hu and Bentler 1999), a good fit can be concluded.



H1: Challenge IS use stressors have a positive mediating effect on routine use via challenge IS use appraisal (0.128, p<0.025)
H2: Challenge IS use stressors have a positive mediating effect on innovative use via challenge IS use appraisal (0.139, p<0.005)
H3: Hindrance IS use stressors have a negative mediating effect on routine use via hindrance IS use appraisal (–0.099; p<0.001)
H4: Hindrance IS use stressors have a negative mediating effect on innovative use via hindrance IS use appraisal (0.040, p>0.200).

Figure 2: Research results of SEM analysis
(Note: values in brackets are R^2 values when only including control variables; IM means intrinsic motivation, EM means extrinsic motivation)[4, 5]

Post-hoc analyses: Qualitative Comparative Analysis

The preceding analysis supports three of the four hypotheses (i.e. H1, H2 and H3). However, the lack of support for H4 means that hindrance IS use stressors have no negative mediating influence on innovative use via hindrance IS use appraisal. This finding is contrary to what was expected and is possibly an interesting one that warrants further investigation. To explore

[4] **Crossed effects of one type of stressors on the other type of appraisal**: While we align with the challenge-hindrance stressor framework suggesting that challenge and hindrance stressors are appraised separately, we also checked whether challenge IS use stressors have an influence on hindrance IS use appraisal and whether hindrance IS use stressors have an influence on challenge IS use appraisal. We tested the model by adding two more relationships. The significance levels included in Figure 2 remain unchanged and the newly added relationships from challenge IS use stressors on hindrance IS use appraisal (β=0.088; p>0.05) as well as from hindrance IS use stressors on challenge IS use appraisal (β=0.077; p>0.05) are both non-significant.

[5] **Relationship between IS use stressors and IS use appraisals**: We plot our data to illustrate whether all users perceiving challenge / hindrance IS use stressors appraise them accordingly and see that there is a significant number which do not. This shows that not all users who perceived a given type of stressor appraise it in the same way. This empirically demonstrated that the stressor appraisal relationship is not tautological (see Appendix C).

possible reasons for this non-significant effect, we perform a post-hoc analysis in the sense of an expansion approach (Venkatesh et al. 2016). SEM is a variable-focused method that particularly identifies symmetric associations. However, it is known that even in symmetric associations with large effect sizes (e.g. as reported above for challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal and hindrance IS use appraisal on routine use (0.463) or innovative use (0.294)), 10 to 20 percent of the cases in a data set follow other, contrarian associations (Spivack and Woodside 2019). A contrarian association means that there is a situation in which a high/low value of an antecedent condition indicates a specific value of an outcome condition without saying that also the inverse value of that antecedent condition is related to values of the outcome condition. This might be in turn a reason for non-significant SEM relationships (see Figure 3, right side and red quadrants). However, there might still be a pattern in these data (e.g. see the similar pattern in both diagrams highlighted in the oval pattern), but this requires using a case-focused method, such as a two-step fuzzy set qualitative comparative analysis (fsQCA), in which we can analyze contrarian associations.

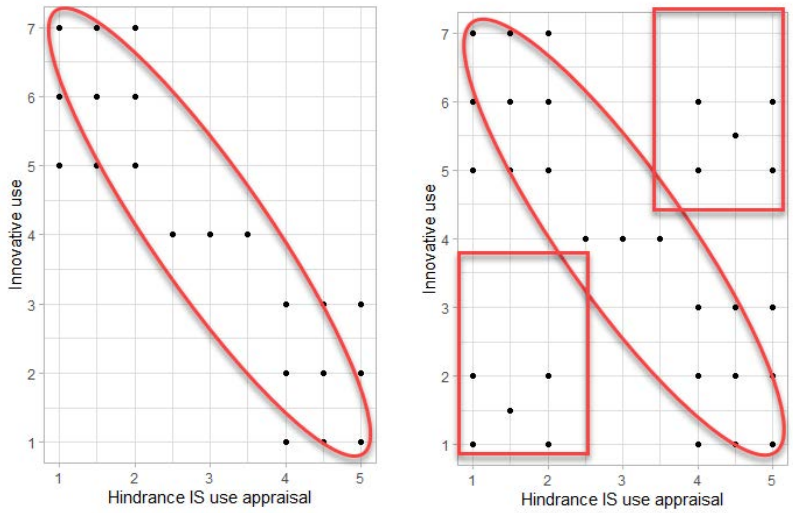


Figure 3: Prototypical and exemplary symmetric relationship between hindrance IS use appraisal and innovative use (left) and prototypical and exemplary contrarian associations that include further, additional cases (right) marked in the two red quadrants

Two-step fsQCA analysis. We first display the cases in crosstabs for the two variables hindrance IS use appraisal and innovative use, which have a non-significant relationship in SEM. Using a 5-point scale for hindrance IS use appraisal and a 7-point scale for innovative use, we are able to display the cases with 35 cells (Figure 4).

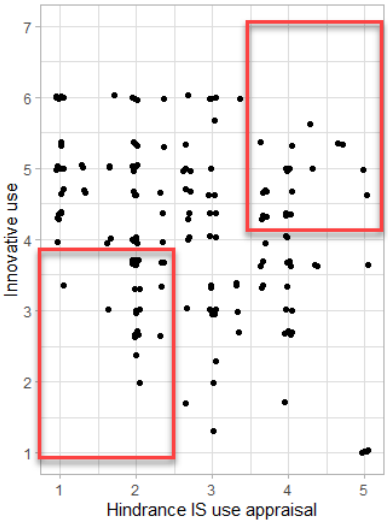


Figure 4: Actual relationship between hindrance IS use appraisal and innovative use. Red quadrants highlight contrarian cases.
Note: We use jitter to avoid overplotting

Notably, Figure 4 highlights that most cases lie on the diagonal as expected, but it is interesting that the majority of cases are in the quadrant of low hindrance IS use appraisal and high innovative use (top left). However, we see that in the quadrant at the bottom right (high hindrance IS use appraisal and low innovative use) there is exactly the same number of cases as at the top right (high hindrance IS use appraisal and high innovative use) and at the bottom left (low hindrance IS use appraisal and low innovative use). This finding indicates a contrarian association, as a symmetric relationship would imply that most cases are in the top left and bottom right quadrants. This suggests the need to perform a two-step fsQCA analysis to consider the cases beyond symmetric associations. Specifically, this can be explained by the following two reasons, which are indicatively illustrated in Figure 4.

First, the non-significant relationship between hindrance IS use appraisal and innovative use may be grounded in causal asymmetry. Causal asymmetry means that the causes for the

occurrence of an outcome (e.g. innovative use) may be different and not the inverse of causes contributing to the non-occurrence of that behavior (Cenfetelli 2004). This can typically occur when cases in the data set have contrarian associations. This cannot be captured by a variable-focused method, such as SEM, because of the underlying assumption that the inverse causes for high level of innovative use contribute to low level of innovative use (see Figures 3 and 4).

Second, the non-significance between hindrance IS use appraisal and innovative use might be grounded in causal complexity of innovative use, which is typically characterized by conjunctural causality and asymmetrical causality (Misangyi et al. 2017). On the one hand, this means that the users' joint perception of challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal and hindrance IS use appraisal altogether contributes to high innovative use. This refers to conjunctural causality that means that an outcome (here: innovative use) does not have a single cause (here: both types of IS use stressors and IS use appraisals). Instead, an outcome "rather result[s] from the interdependence of multiple conditions" (Misangyi et al. 2017 p. 256). On the other hand, high innovative use might only occur when challenge IS use stressors are present while hindrance IS use stressors are absent. This refers to asymmetrical causality that means that the presence and/or absence of multiple conditions (here: challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal, hindrance IS use appraisal) may contribute to innovative use, depending on the presence or absence of the other conditions. All that can lead to the above seen non-significant SEM result (Figure 2). Both might occur when there are cases in the data set that follow contrarian associations (i.e. between hindrance IS use appraisal and innovative use). So, we are interested in respecting the contrarian associations that do not become visible when using SEM with its assumption of symmetric and linear causality between variables and the outcome.

To study contrarian associations as well as investigate the causal asymmetry and causal complexity (i.e. conjunctural causality and asymmetrical causality), we use two-step fuzzy set qualitative comparative analysis (fsQCA). QCA supplements our SEM findings. Even though the main objective is to better understand the non-significant relationship of hindrance IS use appraisal on innovative use, we perform the two-step fsQCA to both IS use behaviors and consider both types of IS use stressors and the associated appraisals. This ensures that we provide a holistic perspective and offer insights into the characteristics of the influence of the two types of IS use stressors and IS use appraisals on routine use and innovative use. In more detail, we identify whether some of these antecedent factors are necessary conditions or contribute to a sufficient configuration for high routine or innovative use.

fsQCA and rationale for using two-step QCA. We use fsQCA to explain how the presence and/or absence of multiple independent variables, which are represented as mathematical sets and called conditions, simultaneously influence the high and/or low level of an outcome (Ragin 2000; Schneider and Wagemann 2012). The simultaneous presence and/or absence of multiple conditions is called configuration (Fiss 2011; Ragin 2000) and fsQCA enables the identification of configurations that are sufficient for the high or low level of an outcome. When a sufficient configuration is present, the outcome needs to be present as well. Furthermore, fsQCA also reveals whether certain conditions are necessary for an outcome. A necessary condition is a variable that is always present if the outcome is present, but whose presence alone does not cause an outcome. In our analysis, we focus on identifying both the sufficient configurations and necessary conditions for high and low routine use and innovative use. To analyze a mediating research model with independent and dependent variables as well as multiple mediating variables, scholars recommend a two-step fuzzy set qualitative comparative analysis (fsQCA) (Schneider and Wagemann 2006). For more detailed information about two-step QCA and fsQCA, please see Appendix D. For that approach we have three kinds of variables: (1) independent variables, also known as distant conditions

(here: challenge IS use stressors and hindrance IS use stressors), (2) mediating variables, also known as close conditions (here: challenge IS use appraisal and hindrance IS use appraisal), and (3) dependent variables, also known as outcome condition (here: routine use and innovative use). With those variables, we follow a two-step approach. In a first step, we analyze what configurations of the independent variables influence the dependent variables. In a second step, we analyze for each configuration found in the first step what configurations of the mediating variables influence the dependent variable. These results are then combined (see Appendix D).

Data analysis with two-step fsQCA. To calibrate and analyze the data, we use the fsQCA software (Ragin 2006), which has been used recently in IS research to study user behavior (Maier et al. 2021a; Mattke et al. 2020). To calibrate the data into fuzzy sets, we used the direct method of calibration with the maximum Likert-value as the fully-in anchor, the median value as the point of maximum ambiguity, and the minimum value as the fully-out anchor (Ragin 2008). To avoid fuzzy values with the value of 0.5, which would result in a dropout of the configuration, we follow recommendations and add a constant of 0.001 (Maier et al. 2021a). Based on the resulting truth tables (see Appendix D), we conduct four separate fsQCAs. The first fsQCA evaluates the necessary conditions and sufficient configurations for high routine use and the second fsQCA evaluates the same for high innovative use. The third and fourth fsQCA evaluate the same for low routine use and low innovative use.

We test for sufficient configuration using a consistency threshold of 0.80, which is above the minimum consistency of 0.75 (Ragin 2008) and increases the overall reliability of the results (Fiss 2011; Mattke et al. 2020). We also follow recommendations to use a frequency threshold of nine, as a higher sample size requires a higher frequency threshold (Rihoux and Ragin 2009). We test for necessary conditions using the recommended consistency threshold of 0.90 (Schneider and Wagemann 2012) indicating the degree to which the cases with the

same conditions display the same outcome. Finally, we set the coverage threshold to 0.60 to avoid trivial necessary conditions (Ragin 2006).

Results and interpretation of the two-step fsQCA. For high routine use, the presence of challenge IS use stressors and challenge IS use appraisal are a sufficient configuration. For low routine use, the absence of challenge IS use stressors and challenge IS use appraisal combined with the presence of hindrance IS use appraisal and hindrance IS use appraisal are a sufficient configuration. No necessary conditions exist for high or low routine use (see Figure 5).

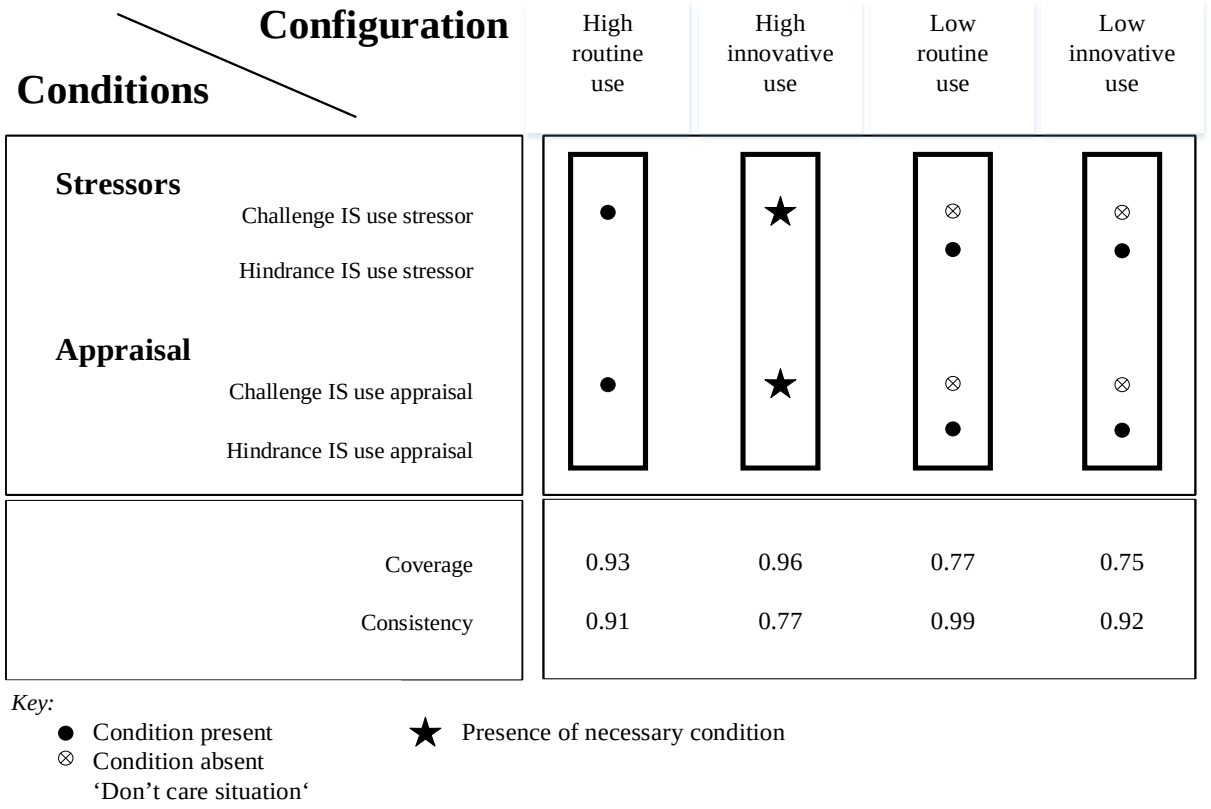


Figure 5: Configurations and QCA results

For high innovative use, the results show that the presence of challenge IS use stressors and challenge IS use appraisal are a sufficient configuration. In addition, the presence of challenge IS use stressors and challenge IS use appraisal are necessary conditions for innovative use. For low innovative use, the presence of hindrance IS use stressors, the absence of challenge IS

use stressors, the presence of hindrance IS use appraisal and the absence of challenge IS use appraisal are a sufficient configuration (see Figure 5).

In addition, the two-step fsQCA results show that the sufficient configurations for low routine use and innovative use are different and not the inverse from the configurations for the high level of these behaviors. This indicates causal asymmetry for high and low routine use and innovative use. Moreover, the coexistence of the absence of challenge IS use stressors and challenge IS use appraisal – for low routine use and innovative use – thereby highlights the causal complexity (in terms of asymmetrical and conjunctural causality), as the presence of hindrance IS use stressors and hindrance IS use appraisal only lead to low routine use and innovative use if challenge IS use stressors and challenge IS use appraisal are absent as well.

As discussed above, our SEM analysis does not support H4. This additional two-step fsQCA analysis enriches the SEM analysis results by identifying cases following contrarian associations implying causal complexity and causal asymmetry, as one cause for the non-significance revealed by SEM.

Sensitivity analysis. Sufficient configurations are highly sensible and depend, among others, on the conditions included in the analysis or the selection of the type of QCA. Accordingly, we re-analyze our data in two respects. First, even though previous research argues that "the notion of 'controls' is usually not part of the analysis" (Fiss et al. 2013 p. 195), we also include the controls of the SEM study in our two-step fsQCA. The results confirm our initial findings, as the analysis still reports four sufficient configurations with the presence of challenge IS use stressors and challenge IS use appraisal as a necessary condition for the high innovative use. In addition, each configuration also includes the controls. This means that the three intrinsic motivations as well as the extrinsic motivation – which we also use in the SEM study (see Figure 2) and are studied in previous IS research (Li et al. 2013) – are also present for high routine use and innovative use. Second, even though a two-step QCA approach is

superior to a one-step QCA for analyzing a mediating relationship, we nonetheless re-analyze the data with a one-step fsQCA. In the cases of high innovative use and high routine use, our findings provide two sufficient configurations in each case. In both cases, the main sufficient configuration (with the highest empirical relevance represented by coverage values) is identical to the findings reported in this paper. In addition, there is a niche configuration in each case (unique coverages <0.035), which includes the hindrance IS use stressors and both types of appraisal. The very low coverage values indicate that these configurations are seldom and not as central as the other two sufficient configurations (Ragin 2006), which are also identified in Figure 5. In both cases, we see that the reported sufficient configurations of the two-step QCA are also included when re-analyzing the data with controls or with a one-step QCA.

Research relevance and transferability to practice

Finally, in addition to the empirical results, we are also interested in how practitioners can work with these results. As recommended by other scholars (Rosemann and Vessey 2008), we perform an applicability check of our results to demonstrate the relevance of our results and their importance, accessibility and suitability to practice (Gill and Bhattacherjee 2009; Te'eni et al. 2018). We also use the interviews to gain further practical insights into the non-significant hypothesis H4 and the QCA results.

Applicability checks are instruments to discuss theoretical and empirical findings with practitioners (Maier et al. 2021b). The data collection of the applicability check was performed with five employees (see Table 4). We conducted interviews using a semi-structured interview guideline protocol (see Appendix E). Each interview lasted between 20 and 30 minutes. Overall, the interviewees confirm our findings and report experiencing them in their work. They also provide comments and perspectives about the implications of our findings for them and their organizations (see Table 4).

Practitioner	Implications for	Comments and perspectives
A deputy chief information officer (business consultancy)	How IS is viewed	*"Explaining what links IS use stress to positive outcomes is extremely important because we always have to justify our software and hardware costs as well as possible adverse consequences including burnout."*
A non-IS employee (business consultancy)	Working with IS	*"Even though IS use stress sounds very negative to me, I agree that I am most innovative and develop routines in using IS when I am challenged … otherwise I just march to my own drummer"*
An IS professional (business consultancy)		*"I love to be challenged by tight time schedules and a lot of work, as it makes me more creative in how to use IS to accomplish tasks faster.*
A director (financial institute, SME)	IS training for users	*"It is rather exciting to see that stress related to the use of technology can also be beneficial for our employees, which we can confirm from our daily business."* *"With the aim of fostering innovative use, we will offer even more training programs to prepare employees in a way that stress results in routine use and innovative use."*
A deputy chief finance officer (financial institute, listed on the DAX share index)	Organizational IS management policies	*"Overcoming the prevailing uncertainty of whether IS use stress is good or bad for employees is essential for society and organizational policies."* *"We see that totally switching off forwarding e-mails in the evening is not a solution for everything ... instead the results aim to control hindrance stressors by establishing clear guidance, regulations, structures and policies towards IS use and give our employees reasons to acquire IS skills to handle the workload by using IS ... where we will set up meaningful performance objectives that stimulate employees and so increase innovative use."*

Table 4: Examples from applicability check

Our interview partners discuss the organizational and individual importance of the topics of this research study. They underscore the need to understand how routine and innovative use is grounded in IS use stress, as exemplified by the following statements of the interviewees:

> *"We know from our daily practice that a routine handling of IS is important in order to work error-free and time-efficient. ... We also encourage our employees to use IS innovatively, especially to optimize work processes."*
>
> *"While the use of IS is typically considered as negative stress hindering employees, it seems highly relevant to me to understand stress from a negative and positive side."*

In terms of the accessibility of the results, several interviewees comment that the configurations are easy to understand. The following statement about the combination of these two analyses, in particular, is typical of all interviewees:

> *"The combination of identifying ways to increase routine use and innovative use is transparent and plausible."*

The suitability of our results is discussed by all interviewees, who saw different implications of the results for their daily practice. We identify four main perspectives discussed by our interviewees (see Table 4). First, they discuss the implications for their general view of IS that IS use stressors are not per se a negative consequence of using IS. Second, they discuss the implications for working with IS, agreeing that they only innovatively use IS if they are challenged by using an IS, concluding that fostering challenge IS use stressors is important to enabling innovative use. Third, they identify implications for IS training and the importance of users evaluating IS use stressors as a challenge rather than as a hindrance to foster routine use and innovative use. Fourth, they highlight implications for organizational IS management policies and the importance of providing guidance for hindrance IS use stressors and to support users in appraising IS use stressors as a challenge.

We also glean further insights into the influence of hindrance IS use stressors and hindrance IS use appraisal on innovative use**.** While the SEM results do not show a mediated effect of hindrance IS use stressors to influence innovative use via hindrance IS use appraisal, the two-step fsQCA results indicate that low and high innovative use are grounded in different factors. Our interviews provide further insight regarding these results.

Interviewees agree that dealing with hindrance IS use stressors is common and habitual for them, as summarize by one interviewee:

> "*It seems really common and habitual for employees to deal with – how do you call it – hindrance IS use stressors. … I would guess that most employees have given up thinking about that, so confrontation with those stressors is habitual and meaningful.*" (deputy CIO of a business consultancy)

Recent research confirms the deputy CIO's observation that employees might consider hindrance IS use stressors habitual, pointing to a possible habituation effect, which is also relevant to IS use stress. If this effect also applies to users confronted with hindrance IS use

stressors, users may get so used to the presence of hindrance IS use stressors that they less frequently appraise them as hindering, thus diminishing their influence on innovative use.

Workarounds are mentioned as a strategy to deal with hindrance IS use stressors, as summarized by the following statement by a non-IS employee:

> "*Oh, I would be rather surprised if [hindrance IS use] stress had no negative effect on whether I use IS innovatively … but, in my experience, system breakdowns are rather common and our ERP system is often unresponsive, so I have developed workarounds and I am really good and fast at performing them, so I am experienced and prepared for that hindering stuff*." (non-IS employee)

Previous research has identified many reasons for developing workarounds. Generally, workarounds are used to avoid using an IS and instead follow non-IS routines to deal with hindrance IS use stressors appraised as hindering. When workarounds are used in response to hindrance IS use stressors, it may mitigate the hindrance IS use stressors' negative influence on innovative use. In other words, practitioners have approached the non-significant effect of the relationship implied by H4 by offering an explanation in terms of the absence of effective workarounds.

Discussion and implications

Productivity gains from ongoing digitalization depend in part on whether IS is used in both routinized and innovative ways (Burton-Jones and Grange 2013; Roberts et al. 2016). At the same time, users are confronted with various IS use demands grounded in their ongoing use of IS on an everyday basis within their workplace environment, which can influence both routine use and innovative use. The present study contributes to the research streams of post-acceptance IS use and IS use stress by investigating the relationship between IS use demands and routine use and innovative use.

Summary and integration of results

In our study, we combine quantitative and qualitative approaches complementing each other to examine how challenge IS use stressors and hindrance IS use stressors influence routine

use and innovative use. The SEM findings show that challenge IS use stressors have a positive mediated effect on routine use and innovative use via challenge IS use appraisal, and hindrance IS use stressors have a negative mediating influence on routine use via hindrance IS use appraisal. Expanding the SEM results with the QCA method, we also examine contrarian associations and find that hindrance IS use stressors and hindrance IS use appraisal are only relevant in the absence of challenge IS use stressors and challenge IS use appraisal, as under this condition they cause both low routine use and innovative use. In the presence of challenge IS use stressors and challenge IS use appraisal, it doesn't matter whether hindrance IS use stressors and hindrance IS use appraisal are absent or present, as under this condition high routine use and high innovative use will be observed. We also reveal that both challenge IS use stressors and challenge IS use appraisal are imperative (necessary condition and sufficient configuration) for high innovative use. Put simply, challenge is a must for high innovative use. The post-survey applicability check confirms the practical relevance of these findings and provides further qualitative explanations of the quantitative results. Together these three sets of analyses generate rich insight regarding how challenge and hindrance IS stressors stemming from demands in the IS use environment can influence routine use and innovative use (see Table 5). For further details of the combination of methods, the derived inferences, and validation see Appendix F.

Main-study testing research hypotheses using SEM (PLSc)	• Identification that challenge IS use stressors have a positive mediating influence on routine use and innovative use through challenge IS use appraisal. • Identification that hindrance IS use stressors have a negative mediating influence on routine use through hindrance IS use appraisal. • Identification that challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal and hindrance IS use appraisal have a higher strength of effect on routine use and innovative use than variables (e.g. extrinsic and intrinsic motivation) studied by previous research.
Post-hoc analysis using QCA (two-step fsQCA)	• Extension of SEM results by also respecting contrarian associations. • Identification of challenge IS use stressors and challenge IS use appraisal as necessary for high innovative use.

	• Identification that high vs low routine use and high vs low innovative use is grounded in different and not inverse antecedent factors (causal asymmetry). • Identification that routine use and innovative use are caused by more than one condition that can be present and absent (causal complexity).
Applicability check analyzing relevance and transferability for practice	• Identification of the importance, accessibility and suitability to practice of our research question by interviewing different individuals.

Table 5: Summary of combined research findings

Implications for IS theory

This study contributes to the literature in the stream of post-acceptance research by investigating the antecedents of routine use and innovative use. We develop theory explaining that challenge IS use stressors appraised as such are the basis for routine use. We know from literature that using IS for a certain task causes the development of routines (Burton-Jones and Grange 2013; Polites and Karahanna 2013). This includes, among others, simple (non-challenging) repeated IS use over time (Agarwal and Prasad 1999; Polites and Karahanna 2013). Building on this idea, we show that routine use might also stem from the presence of challenge IS use stressors and challenge IS use appraisal, where these stressors drive the user to IS use and hence facilitate routine development. This is a novel approach to looking at routine use. We also demonstrate that users only pursue innovative use in the presence of challenge IS use stressors which they appraise accordingly. Research posits that users are shackled to the status quo when using IS (Laumer et al. 2015; Lee and Joshi 2017), and avoid investing time and effort in leaving the status quo (Maier et al. 2015b; Mattke et al. 2018). Such a status quo bias implies that users might use IS habitually without innovatively finding novel uses. However, we know that disruptions can lead users to rethink well-established work processes (Polites and Karahanna 2013), which can lead to innovative use. Indeed, it has been argued that users only adapt to new IS use behaviors when confronted with new challenges (Sun 2012). Such challenges may be embodied in challenge IS use stressors appraised as such. Without a challenge IS use appraisal, the user might continue to use the IS

without innovation. Overall, our study thus establishes a set of novel theoretical antecedental processes for routine use and innovative use in terms of mediating influences of challenge IS use stressors via challenge IS use appraisal, and hindrance IS use stressors via hindrance IS use appraisal.

IS use research into inhibiting and enabling factors (Cenfetelli 2004) shows that the presence of hindrance IS use stressors might discourage IS use. Among others, we know that uncertainty, intrusiveness, being overloaded by information or irrelevant requests discourage IS use, lowering the chance of developing routines or identifying innovative ways of using the IS (Cenfetelli and Schwarz 2011). Our research, on the other hand, demonstrates that hindrance IS use stressors rule out both routine use and innovative use, but only when challenge IS use stressors and challenge IS use appraisal are absent. In other words, when a user is confronted with hindrance IS use stressors and appraises them as a hindrance, they will neither develop a routine way of working with the IS nor identify innovative ways of using the IS unless they also perceive challenge IS use stressors and appraises them as challenging. We are thus able to show that enablers and inhibitors influence routine use and innovative use together, and that this combined influence offers more insights into the interplay of enablers and inhibitors that just studying enablers or inhibitors separately.

We further contribute to IS use stress literature. Current IS use stress research has primarily focused on negative effects (e.g. Ragu-Nathan et al. 2008), arguing that IS use stressors overwhelmingly lead to perceived exhaustion (Ayyagari et al. 2011) or to IS use discontinuation (Maier et al. 2015b), among others. We extend this understanding by theorizing and demonstrating that IS use stressors can also have positive consequences. We theorize and validate that there are – in addition to hindrance IS use stressors – also challenge IS use stressors. Recognizing this difference offers a more nuanced and complex understanding of user behavior in relation to IS use stress. Further, IS use stress literature has

so far focused on IS use stressors and their influence on users' psychological and behavioral reactions (Tarafdar et al. 2010). We conceptually extend this literature by demonstrating the role of appraisal. Appraisal vis-à-vis stress from use of IT is an emerging topic with not much existing research (Stich et al. 2019; Tarafdar et al. 2019). We suggest that IS use behavior (in this case routine use and innovative use) is influenced by IS use stressors only in the presence of the relevant appraisal (Appendix C).

Finally, we theoretically integrate the two streams of post-acceptance and IS use stress research by demonstrating that the antecedents of routine use and innovative use emerge from IS use demands. Research shows that user motivation guides post-acceptance behavior (Li et al. 2013) and that IS use stress causes IS discontinuation (Maier et al. 2015b). We extend this understanding by demonstrating that the appraisal of ongoing IS use stressors influences routine use and innovative use. In this new theoretical direction, we consider IS use stressors as antecedents of routine use and innovative use. We explain that both challenge IS use stressors and hindrance IS use stressors influence post-acceptance IS use via appraisal. We offer insights into what factors influence post-acceptance use behavior (challenge IS use stressors and hindrance IS use stressors), how these factors yield influence (via challenge IS use appraisal and hindrance IS use appraisal), the conditions necessary for highly innovative use (challenge IS use stressors and challenge IS use appraisal), and why this occurs (independent appraisal of challenge IS use stressors and hindrance IS use stressors influence routine use and innovative use). With these insights, we offer a theoretical approach that uses IS use stress to explain routine use and innovative use.

Implications for IS research methods

Our research follows a novel three-step research design including SEM analysis, QCA analysis and an applicability check. First, we use SEM analysis to test our research hypotheses based on survey data. Second, we extend the SEM analysis by undertaking a two-step fsQCA, which investigated cases in the data set that follow contrarian associations, and

in doing so generated two important insights. One, we identify causal asymmetry between the antecedent conditions influencing low and high routine use and innovative use. Two, we identify causal complexity, to the degree that routine use and innovative use are caused by more than one condition. With this combination of two methods, we could identify symmetric associations (through the variable-focused method SEM) as well as contrarian associations (through the case-focused method QCA). To our knowledge, this is the first study in IS to complement SEM with two-step fsQCA to reveal a richer and wider set of more unexpected insights than SEM analysis alone (see Table 5). In a third step, our applicability check helps us evaluate the practical value of our study (Gill and Bhattacherjee 2009; Te'eni et al. 2018). Rosemann and Vessey (2008) emphasize that it is important to illustrate importance, accessibility and suitability of research results to support their transfer to practice.

With our approach of mixing methods, we follow recent suggestions (Leidner 2020) that combining particular methods (in this case SEM and two-step QCA) represents a specific form of methods contributions, particularly when it generates novel theoretical insights, and is a forerunner in timing.

Implications for IS practice

Our results are also valuable for and accessible to the practice of managing IS. First, our study helps organizations understand that the presence of IS use stressors can be challenging in a positive way. Accordingly, conditions such as high workload that require the use of an IS, or working with an IS under time pressure can be beneficial in terms of enhancing both routine use and innovative use of IS. Second, organizations should focus on reducing hindrance IS use stressors such as system breakdowns or unclear IS instructions. Since such stressors may be unavoidable in everyday work with IS, organizations should help users to deal with them effectively, such as by offering support. Third, organizations should also foster challenging IS use stressors, such as motivating users to deal with a high workload, meet pressing deadlines or performing complex but important tasks – through the use of IS. Indeed, our results

indicate that the presence of such stressors and their appraisal as challenges are necessary for innovative use. Fourth, organizational IS management policies should acknowledge and reflect the possibility of both challenge IS use stressors and hindrance IS use stressors co-existing. Accordingly, IS use policies, such as shutting down e-mail servers in the evening and restrictive bring-your-own-device policies (Valta et al. 2021), should be re-evaluated in terms of their impact on both negative hindrance and positive challenge IS use stressors.

Limitations and future research

This research is limited in several ways. First, since we collect data within a single organization, participants came from the same technology environment and organizational culture. It is possible that the effects of challenge IS use stressors and hindrance IS use stressors are different for different organizations. This limitation may affect the generalizability of our findings.

There is room for future research to study the relationship between IS use stressors and IS use appraisals or even IS use behaviors. Among others, we know from general work stress research (Bakker et al. 2010) and IS use stress research (Maier et al. 2019) that users appraise stressors differently depending on their personality. Future research can consider the impact of user personality on the appraisal of the stressors and on routine use and innovative use. Beyond that, we see that there is a substantial percentage of users who report that they perceive challenge IS use stressors or hindrance IS use stressors but do not appraise them accordingly (Figure 6, Appendix C). Explanations for this is important to understand why individuals may not appraise the stressors in the same way. Based on previous research (LePine et al. 2016), we made an ex-ante classification of challenge IS use stressors, hindrance IS use stressors, challenge IS use appraisal, and hindrance IS use appraisal. However, it is possible that users appraise certain use stressors as challenging while others may appraise the same as hindering depending on their experience, training, profession,

personality type or corporate culture among others, so that this might be worth to study in future.

Conclusion

Routine use and innovative use are two important facets of post-acceptance IS use. IS use stressors represent important IS-related demands in the work environment. This study integrates the two. It investigates two kinds of IS use stressors, namely, challenge IS use stressors and hindrance IS use stressors, as antecedents of routine use and innovative use. We find that challenge IS use stressors appraised as challenges can foster both routine use and innovative use, while hindrance IS use stressors appraised as hindrances inhibit routine use and innovative use. We further suggest that users will only innovatively use IS if they experience challenge IS use stressors and appraise them as challenges, irrespective of the presence of hindrance IS use stressors.

Appendix A: Classification, Scale Development and Measures

Previous research provides no IS-specific measures for challenge IS use stressors and hindrance IS use stressors. However, as items for challenge IS use stressors and hindrance IS use stressors are related to previous general (LePine et al. 2016) and IS-related stress research (Ragu-Nathan et al. 2008), we used items from those measures to develop an initial pool of items for challenge IS use stressors and hindrance IS use stressors (Chau 1999). We then discussed the items within our research team and with employees working for the organization in which we performed our survey study. The feedback was used to redefine the items, resulting in ten items each for challenge IS use stressor and hindrance IS use stressor. In keeping with Nahm et al.'s (2002) recommendation to validate items before using them in a survey, we followed a q-sort method derived from Q-methodology (Stephenson 1953). After 64 individuals sorted items according to our set of constructs, we calculated agreement ratios. As suggested in prior research (Landis and Koch 1977; Nahm et al. 2002), we rejected three items which were assigned correctly by less than 61% of the respondents. This process resulted in nine items to measure challenge IS use stressors and eight items to measure hindrance IS use stressors (Tables 6 and 7).

	Challenge IS use stressors (CISS)	Hindrance IS use stressors (HISS)	No assignment / assignment to other constructs
CISS1	85.9		
CISS2	64.1		
CISS3	75.0		
CISS4	76.6		
CISS5	81.3		
CISS6	82.8		
CISS7	87.5		
CISS8	82.8		
CISS9	85.9		
CISD10	51.6		
HISS1		82.8	
HISS2		65.6	
HISS3		90.6	
HISS4		75.0	
HISS5		89.1	
HISS6		84.4	
HISS7		90.6	
HISS8		82.8	
HISS9			
HISS10		54.7	
Note: only values higher than 50% are displayed			

Table 6: Results of q-sorting method to assess reliability and construct validity (values in percentage); Classification of IS use stressors.

Construct	Item	Loading
How often did you experience the following in your work today?		
Challenge IS use stressors	I have to complete a lot of work using ICT.	0.735
	I have to work very hard using ICT.	n.s.

(self-developed[6])	I have to work with very tight time schedules using ICT.	0.743
	I have to work at a rapid pace to complete all of my tasks using ICT.	0.782
	I have to perform complex tasks using ICT.	0.798
	I have to use a broad set of ICT-related skills and abilities.	0.793
	I have to balance several projects/tasks that require ICT use.	0.840
	I have to multitask assigned projects/tasks that require a lot of ICT use.	0.812
	I have high levels of ICT responsibilities.	0.791
Hindrance IS use stressors (self-developed[4])	I have several hassles using ICT (e.g., system breakdown, software updates)	0.711
	I have constraints to complete my work using ICT (e.g. missing features, delays).	n.s.
	I have unclear instructions from my bosses on how to use ICT.	0.766
	I have to deal with unclear ICT features.	0.796
	I have conflicts using ICT.	0.799
	I have inadequate ICT resources to accomplish tasks.	0.741
	I have conflicts with peers about using ICT.	0.799
	I have disputes with coworkers about using ICT.	0.808
Please evaluate the following statements.		
Challenge IS use appraisal (adapted by LePine et al. 2016)	Fulfilling the IS use demands helps to improve my personal growth and well-being.	0.880
	I feel the IS use demands challenge me to achieve personal goals and accomplishment.	0.860
	In general, I feel that the IS use demands promote my personal accomplishments	0.891
Hindrance IS use appraisal (adapted by LePine et al. 2016)	Fulfilling the IS use demands thwarts my personal growth and well-being.	0.877
	I feel the IS use demands constrain my achievement of personal goals and development.	0.940
	In general, I feel that the IS use demands hinder personal accomplishment	0.910
Routine use (Li et al. 2013)	My use of ICT has been incorporated into my regular work practices.	0.899
	My use of ICT is pretty much integrated as part of my normal work routine.	0.921
	My use of ICT is now a normal part of my work.	0.908
Innovative use	I have discovered new uses of ICT to enhance my work performance	0.881

[6] Following LePine et al. (2016), these items do not include information about the evaluation. It focuses on the presence of those stressors, which are classified upfront in the pre-test.

(Li et al. 2013)	I have used ICT in novel ways to support my work.	0.896
	I have developed new applications based on ICT to support my work	0.782
Why do you use ICT?		
Intrinsic motivation toward accomplishment (Li et al. 2013)	Because I feel a lot of personal satisfaction while mastering certain difficult skills when using ICT	0.873
	For the pleasure I feel while improving some of my weakness when using ICT.	0.854
	For the satisfaction I experience while I am perfecting my use of ICT.	0.896
	For the satisfaction I feel while overcoming certain difficulties when using ICT.	0.878
Intrinsic motivation to know (Li et al. 2013)	For the pleasure it gives me to know more about the BIS.	0.897
	For the pleasure I feel while learning new things when using ICT.	0.937
	For the pleasure of developing new skills when using ICT.	0.928
Intrinsic motivation to experience stimulation (Li et al. 2013)	I find using ICT to be enjoyable.	0.923
	The actual process of using ICT is pleasant.	0.923
	I have fun using ICT.	0.923
Extrinsic motivation (Li et al. 2013)	Using ICT in my job enables me to accomplish tasks more quickly.	0.891
	Using ICT improves my job performance.	0.876
	Using ICT in my job increases my productivity.	0.871
	Using ICT enhances my effectiveness in my job.	0.907

Table 7: Items, measures and loadings
(Note: Two items marked n.s. were removed while analyzing the data because loadings were <0.707, indicating non-significance)

Appendix B: Sample Size, CMB, Measurement Model

Required sample size. Within our research model, routine use and innovative use have both the highest number of antecedents. Both have six antecedents in terms of challenge IS use appraisal and hindrance IS use appraisal as well as the four control variables. Thus, to technically use the PLS algorithm, we need a sample size higher than 60 (multiplication of: 6 (six antecedents) * 10). We also followed Kim's (2005) suggestion that a given level of power depends on a) number of variables / degrees of freedom, b) the relation among the variables, c) choice of fit index and d) the value of the fit index and proposes a range of different fit indexes. Using Steiger's gamma (with γ=0.95; α=0.05; *Power* = 0.90), the proposed sample size is 114.7 and using RMSEA (α=0.05; *Power* = 0.90) reveals a minimum proposed sample size of 101.0 for the proposed research model. The sample size of our study meets all of these conditions, so that the sample size with 178 participants is higher than the required sample size.

Common method bias. Empirical research must consider common method bias (CMB) in self-reported data (Podsakoff et al. 2003). To determine the extent of CMB, we ran four different tests. The results of the first test, Harman's single factor test, which indicates whether the majority of the variance can be explained by one single factor, show that only 24.7 percent of the variance of the data is explained by one factor. Second, we included a marker variable ("*Coffee is important in my life*") in our research model. We expected that this variable was not highly correlated with other constructs considered in our study. Following the technique suggested by Lindell and Whitney (2001), and the recommendation of Chin et al. (2012) to a priori choice of a theoretical unrelated marker variable, we used the second-smallest positive correlation among the constructs measured and the marker variable (0.02 for both studies). We then developed a CMB-adjusted correlation matrix to examine the structural relationships in the research model (Malhotra et al. 2006). Our results indicate that the directions and significance levels of the paths remained unchanged. Third, we used the procedure of examining the correlation matrix as specified by Pavlou et al. (2007). Extremely high correlations ($r > 0.90$) are an indicator of CMB but our correlation matrix did not indicate such high correlations. The fourth test was proposed by Williams et al. (2003), who suggest determining the extent of CMB with the help of PLS by including a CMB factor into the model. All remaining factors are transformed into several single-item constructs and the ratio of R^2 with a CMB factor is compared to R^2 without a CMB factor. Comparing the average R^2 without a CMB factor and the delta R^2 that could be explained with the CMB factor, this result in a ratio of 1:193, i.e. no observable signs of CMB influence. In addition, the path coefficients from the CMB factor and the original constructs and had a ratio of 1:252. Finally, our results reveal that only one path coefficient from the CMB factor to the single-item constructs is significant. Comparing this with prior results indicate that CMB might not distort the results.

Measurement Model. The data to valid the measurement model is included in Table 8. It includes CR, Ave and bivariate correlations.

		Mean	Std	α	CR	AVE	1	2	3	4	5	6	7	8	9	10
1	Challenge IS use stressors	3.33	1.1	0.91	0.93	0.62	0.788									
2	Challenge IS use appraisal	3.82	0.9	0.85	0.91	0.77	0.510	0.877								
3	Hindrance IS use stressors	2.45	1.0	0.89	0.91	0.60	0.123	-0.054	0.775							
4	Hindrance IS use appraisal	2.52	1.1	0.90	0.94	0.83	-0.109	-0.248	0.517	0.909						
5	Innovative use	4.91	1.5	0.81	0.89	0.73	0.506	0.545	0.022	-0.086	0.855					
6	Routine use	5.73	1.2	0.90	0.94	0.83	0.403	0.415	-0.145	-0.371	0.511	0.909				
7	IM toward accomplishment	4.91	1.4	0.90	0.93	0.77	0.288	0.479	-0.064	-0.110	0.427	0.394	0.875			
8	IM to know	5.07	1.3	0.91	0.94	0.85	0.374	0.434	-0.064	-0.126	0.435	0.461	0.678	0.921		
9	IM to experience stimulation	5.06	1.3	0.91	0.95	0.85	0.317	0.483	-0.174	-0.176	0.446	0.479	0.611	0.608	0.923	
10	EM	5.71	1.2	0.91	0.94	0.79	0.365	0.425	-0.232	-0.360	0.418	0.439	0.433	0.435	0.562	0.886

Note: Square root of AVE is listed on the diagonale of bivariate correlations;
IM = intrinsic motivation, EM = extrinsic motivation,
IS use stressors: (1) never - (5) extremly often;
IS use appraisal: (1) disagree - (5) agree;
use and controls: (1) strongly disagree - (7) strongly agree;

Table 8: AVE, CR and bivariate correlations

Appendix C: Data plot for the relationship between IS use stressors and IS use appraisal

To illustrate that not all users that perceive challenge IS use stressors appraise them accordingly and that not all users perceiving hindrance IS use stressors appraise them as hindering, we plotted the results (see Figure 6).

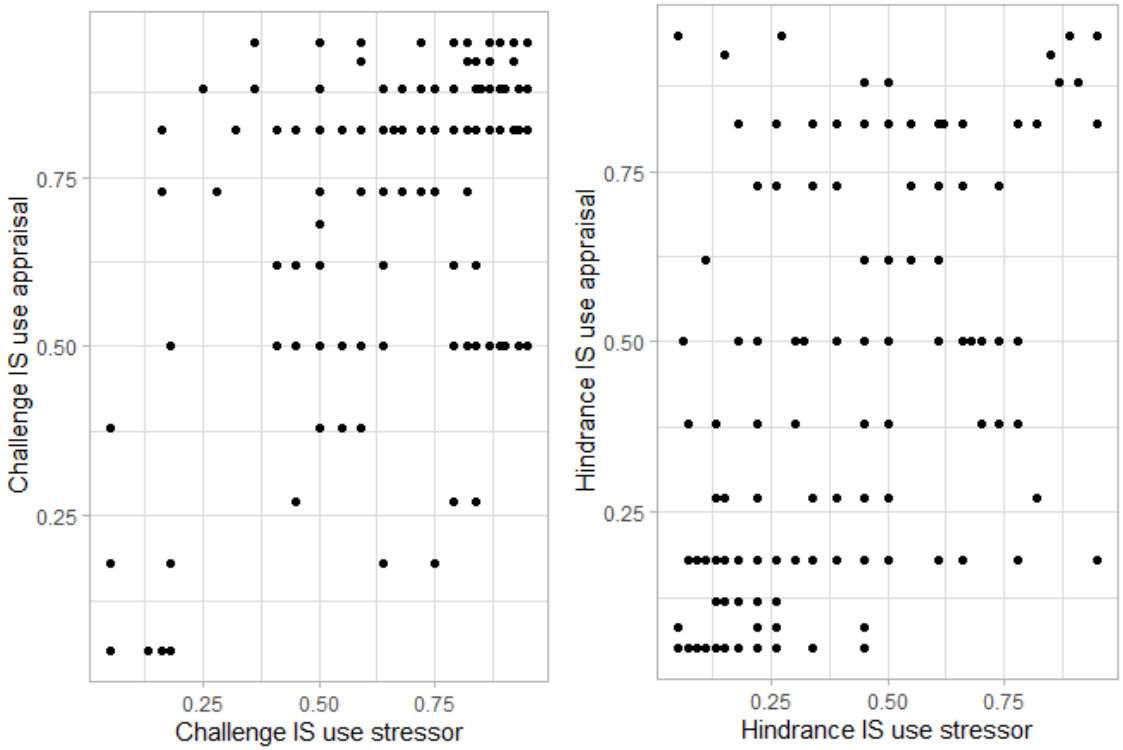


Figure 6: Relationship between challenge IS use stressor and challenge IS use appraisal (left) as well as hindrance IS use stressor and hindrance IS use appraisal (right)

Results show that 14 percent of all users perceiving challenge IS use stressors do not appraise them as challenging and 23 percent of the users perceiving hindrance IS use stressors do not appraise them as hindering.

Appendix D: Types of QCA, the Two-step QCA and Performing the two-step fsQCA

Three types of QCA

There are three main types of QCA used in research: crisp set QCA (csQCA), multi-value QCA (mvQCA) and fuzzy set QCA (fsQCA). These types of QCA differ in terms of how conditions are coded. The csQCA codes conditions in the two binary values '0' or '1'. The mvQCA usually uses more than two values to code conditions. The fsQCA allows a condition to have value from '0' to '1' (Schneider and Wagemann 2012). In this study, we use fsQCA because the nature of our outcome variables (routine use and innovative use) can have continuous variables; meaning that the extent of routine use and innovative use can be low, medium, high and all values in-between.

The two-step QCA approach

In *step one* of the two-step QCA approach, the distant conditions, contextualized here as challenge IS use stressors and hindrance IS use stressors, are analyzed to identify sufficient configurations of distant conditions or (outcome-enabling configurations) which lead to the outcome. In *step two*, the close conditions, contextualized here as challenge IS use appraisal and hindrance IS use appraisal, are analyzed to identify sufficient configurations of close conditions that lead to the outcome within the outcome-enabling configurations identified in step one. Using separated datasheets for each outcome-enabling configuration from step one, we added only configurations of close conditions in which the configuration of distant conditions equals this specific outcome-enabling configuration. We then used these new datasheets to analyze sufficient configurations of close conditions. Thus, there are as many analyses of sufficient configurations of close conditions as there are outcome-enabling configurations (Schneider and Wagemann 2006).

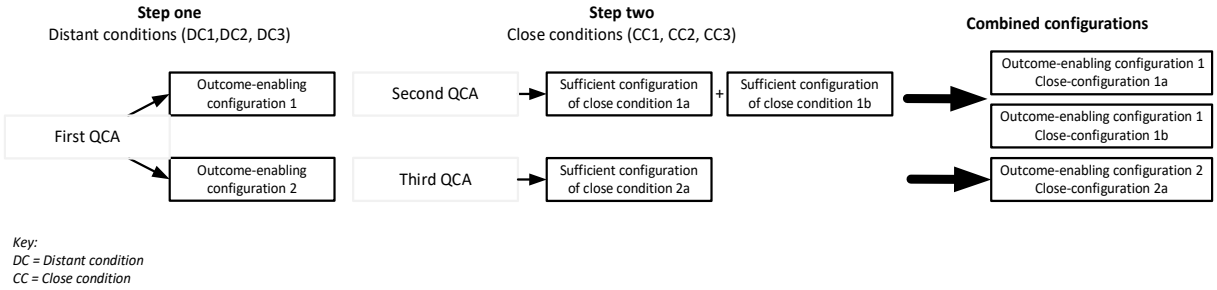


Figure 7. Two-step QCA Process (Schneider and Wagemann 2006)

Let us illustrate the two-step process using an example (Figure 7). If there are three distant conditions (DC1, DC2 and DC3) and step one — thus the first QCA — reveals two sufficient configurations leading to the outcome (outcome-enabling configuration 1 and 2), two separated datasheets are created. The first data sheet contains only observations which matches the outcome-enabling configuration 1 and the second datasheet contains all observations which match the outcome-enabling configuration 2. Then an analysis of sufficient configurations of close conditions is conducted for each of the outcome-enabling configurations. In our example, the analysis for sufficient configurations of close conditions (CC1, CC2, CC3) is conducted for outcome-enabling configurations 1 (second QCA) and for outcome-enabling configurations 2 (third QCA). This results in different sufficient configurations of close conditions leading to the outcome for each outcome-enabling

configuration. For instance, the analysis within the outcome-enabling configuration 1 reveals two sufficient configurations of close condition (1a and 1b) and the analysis within the outcome-enabling configuration 2 reveals one sufficient configuration of close condition 2a. Finally, each outcome-enabling configuration from step one is combined with the revealed sufficient configurations of close conditions from step two, resulting in combined configurations. In the example, this results in three combined configurations.

Performing the two-step fsQCA

This paper takes a two-step fsQCA to analyze sufficient configurations of high/low innovative use and high/low routine use.

We first analyze the distant conditions (here: challenge IS use stressor and hindrance IS use stressor) to reveal outcome-enabling configurations for high routine use and innovative use as well as for low routine use and innovative use. In line with recommendations from QCA literature we used a consistency threshold of 0.80 results (Fiss 2011) and a frequency threshold of nine, which represents five percent of the data sample (Mattke et al. 2018). For this, we base on the truth tables for step 1 and apply the Quine-McCluskey algorithm to minimize the configurations (see Table 9 for the truth table for high routine use and innovative use and Table 10 for low routine use and innovative use).

CS	HS	number	RU	raw consistency	CS	HS	number	IU	raw consistency
1	0	109	1	0.95	1	0	109	1	0.85
1	1	36	1	0.94	1	1	36	1	0.9
0	1	27	0	0.75	0	1	27	0	0.75
0	0	6	0	0.91	0	0	6	0	0.87
Note: *CS = challenge IS user stressor; HS = hindrance IS use stressor* *RU = high routine use; IU = high innovative use*									

Table 9. Truth tables for high routine use and high innovative use in step 1

CS	HS	number	~RU	raw consistency	CS	HS	number	~IU	raw consistency
1	0	109	0	0.38	1	0	109	0	0.58
1	1	36	0	0.57	1	1	36	0	0.7
0	1	27	1	0.80	0	1	27	1	0.84
0	0	6	0	0.71	0	0	6	0	0.87
Note: *CS = challenge IS user stressor; HS = hindrance IS use stressor* *~RU = low routine use; ~IU = low innovative use*									

Table 10. Truth tables for low routine use and low innovative use in step 1

We then evaluate the close conditions (here: challenge IS use appraisal and hindrance IS use appraisal) within each outcome enabling configuration. We again used a consistency threshold of 0.80 and again a frequency threshold of nine. The truth tables for step 2 are reported in Table 11 for high routine use and innovative use and in Table 12 for low routine use and innovative use. We again used the Quine-McCluskey algorithm to minimize the configurations.

CA	HA	number	RU	raw consistency	CA	HA	number	IU	raw consistency
1	0	92	1	0.95	1	0	92	1	0.8
1	1	45	1	0.91	1	1	45	1	0.88

0	1	7	0	0.93		0	1	7	0	0.87
0	0	1	0	0.96		0	0	1	0	0.91
Note: *CA = challenge IS use appraisal; HA = hindrance IS use appraisal* *RU = High routine use; IU = High innovative use*										

Table 11. Truth tables for high routine use and high innovative use in step 2

CA	HA	number	~RU	raw consistency		CA	HA	number	~IU	raw consistency
0	1	13	1	0.98		0	1	13	1	0.92
1	1	12	0	0.68		1	1	12	0	0.78
0	0	1	0	0.99		0	0	1	0	1
1	0	1	0	0.96		1	0	1	0	1
Note: *CA = challenge IS use appraisal; HA = hindrance IS use appraisal* *~RU = low routine use; ~IU = low innovative use*										

Table 12. Truth tables for low routine use; and low innovative use in step 2

In all truth tables, we have a logical remainder index of zero, which indicates that the data includes all logical possible configuration and that limited diversity is not an issue. Afterwards, we combine the results of the outcome-enabling configuration with the configuration revealed from the analysis of close conditions. The results of the combined configurations are displayed in the following subsections.

Sufficient configurations and necessary conditions for high and low routine use

Sufficient configurations. For high routine use, the fsQCA concludes the following results. The analysis for sufficient configurations reveals the following Boolean expression:

*Challenge IS use stressors * challenge IS use appraisal → routine use*

The results show that the presence of challenge IS use stressors and challenge IS use appraisal are a sufficient configuration for high routine use. The configuration has an overall consistency of 0.91 and a coverage of 0.93.

For low routine use, the fsQCA analysis reveals the following results. The analysis for sufficient configuration reveals the following Boolean expression:

*Hindrance IS use stressors * ~challenge IS use stressors * hindrance IS use appraisal * ~challenge IS use appraisal → ~routine use*

The Boolean expression means that the presence hindrance IS use stressors, the absence of challenge IS use stressors, the presence of hindrance IS use appraisal and the absence of challenge IS use appraisal are a sufficient configuration for low routine use, with an overall consistency of 0.99 and a coverage of 0.77.

Necessary conditions. The analysis of necessary conditions reveals if any present condition or if any absence of a condition is necessary for the outcome. We use a consistency threshold of 0.90, which needs to be exceeded to reveal a necessary condition (Ragin 2000; Schneider and Wagemann 2012). The results of the necessary condition analysis for high routine use and low routine use are displayed in Table 13. The analysis of necessary conditions reveals no necessary condition, as all values are below the required threshold (Schneider and Wagemann 2012).

	High routine use		Low routine use	
	Consistency	Coverage	Consistency	Coverage
Challenge IS use stressors	0.85	0.93	0.70	0.34
~ Challenge IS use stressors	0.39	0.75	0.86	0.63
Challenge IS use appraisal	0.87	0.90	0.72	0.31
~ Challenge IS use appraisal	0.29	0.70	0.77	0.82
Hindrance IS use stressors	0.46	0.79	0.83	0.62
~ Hindrance IS use stressors	0.78	0.93	0.73	0.37
Hindrance IS use appraisal	0.44	0.74	0.86	0.63
~ Hindrance IS use appraisal	0.78	0.93	0.64	0.34
Note: ~ indicates the absence of a condition or outcome; necessity consistency threshold = 0.90				

Table 13: Necessary conditions test for high and low routine use

Sufficient configurations and necessary conditions for high and low innovative use

Sufficient configurations. For high innovative use, the fsQCA concludes the following sufficient configuration. The analysis for sufficient configurations reveals the following Boolean expression:

*Challenge IS use stressors * challenge IS use appraisal → innovative use*

The results thereby show that the presence of challenge IS use stressors and challenge IS use appraisal are a sufficient configuration for high innovative use. The configuration has an overall consistency of 0.77 and a coverage of 0.96. Coverage measures the proportion of cases explained by the configuration (Ragin 2006).

For low innovative use, the fsQCA analysis reveals the following results. The analysis for sufficient configurations reveals the following Boolean expression:

*Hindrance IS use stressors * ~challenge IS use stressors * hindrance IS use appraisal * ~challenge IS use appraisal → ~innovative use*

The results show that the presence of hindrance IS use stressors, the absence of challenge IS use stressors, the presence of hindrance IS use appraisal and the absence of challenge IS use appraisal are a sufficient configuration for low innovative use. The results depict an overall consistency of 0.92 and a coverage of 0.75.

Necessary conditions. The results for the analysis of necessary conditions regarding high innovative use and low innovative use are displayed in Table 14. The analysis for necessary conditions reveals *challenge IS use stressors* (consistency > 0.92, coverage > 0.80) and *challenge IS use appraisal* (consistency > 0.96, coverage > 0.74) to be *necessary conditions* for high innovative use. The analysis for necessary conditions reveals no necessary condition for low innovative use.

	High innovative use		Low innovative use	
	Consistency	Coverage	Consistency	Coverage
Challenge IS use stressors	**0.92**	**0.80**	0.76	0.53
~ Challenge IS use stressors	0.46	0.70	0.71	0.87
Challenge IS use appraisal	**0.96**	**0.74**	0.77	0.48
~ Challenge IS use appraisal	0.33	0.65	0.59	0.93
Hindrance IS use stressors	0.58	0.73	0.67	0.75
~ Hindrance IS use stressors	0.78	0.76	0.76	0.57
Hindrance IS use appraisal	0.52	0.70	0.67	0.71
~ Hindrance IS use appraisal	0.78	0.74	0.71	0.55
Note: ~ indicates the absence of a condition or outcome; necessity consistency threshold = 0.90, coverage threshold = 0.60; conditions exceeding the consistency threshold are marked as bold				

Table 14: Necessary conditions test for high and low innovative use

Appendix E: Interview protocol for applicability check

0 Demographic questions
0.1 Can you give us some insights into your professional experience?
0.2 What is your current position and since when have you been in that position?
0.2 What information systems do you use in your organization?
1 General IS use stress questions
1.1 Is the topic under consideration (IS use stress, IS use) significant?
1.2 Have you experienced IS use stress in your job?
1.3 What are/were the consequences of those IS use stress experiences?
2 Different types and appraisal of IS use stress questions
2.1 Do you understand the results provided to you?
2.2 Did you observe different types of IS use stressors in your job which might have opposite effects?
2.3 Does the presence and absence of those different types of IS use stressors affect your behavior identical?
3 IS use stress and IS use
3.1 What is the role of IS use stress concerning your daily IS use?
3.2 Can you tell us a case when IS use stress was positive and/or negative for how you use IS?
3.3 What is the role of IS use stress concerning your daily IS use?
4 Implications
4.1 What are your main take-aways from those insights for you/your organization?
4.2 Do you view IS differently than before?

Table 15: Semi-structured interview guideline. We showed interviewees our research model and the findings after the interviewee responded to questions '0 Demographic questions' and '1 General IS use stress questions'.

Appendix F: Integration and validation of combined results

Following the examples of prior research (Venkatesh et al. 2013), we want to leverage the combined results of our three complementing studies to deduce a deeper understanding of how challenge IS use stressors and hindrance IS use stressors influence routine use and innovative use. This requires first, the deduction of complementary knowledge gained from the combination of the three studies and, second, the validation of the individual and combined results.

Complementary knowledge gained from all three studies

The SEM results indicate that challenge IS use stressors have a positive mediating influence on routine use and innovative use through challenge IS use appraisal. This is consistent with the QCA and interview results, showing that challenge IS use stressors and challenge IS use appraisal need to be present for a high routine and innovative use. The QCA results complement these insights by identifying that challenge IS use stressors and challenge IS use appraisal are even necessary for high innovative use. Therefore, we conclude:

> *Challenge IS use stressors foster routine use and innovative use through challenge IS use appraisal; and challenge IS use stressors and challenge IS use appraisal are even necessary for innovative use.*

Further, our SEM results indicate that hindrance IS use stressors have a negative mediating influence on routine use through hindrance IS use appraisal, but no influence on innovative use. While the QCA results support the influence on routine use, they show that hindrance IS use stressors can result in low innovative use through hindrance IS use appraisal, if challenge IS use stressors and challenge IS use appraisal are absent. The interviews further indicate that hindrance IS use stressors have a negative effect on innovative use. So, we conclude:

> *Hindrance IS use stressors hinder routine use and innovative use through hindrance IS use appraisal, if challenge IS use stressors and challenge IS use appraisal are absent.*

Validation of results

Design quality. The purpose of combining different research methods is clearly stated: The QCA results expand the results of our SEM analysis and the post-hoc applicability check offers complementary knowledge on the practical value of our theorization. Following our research model explaining how challenge IS use stressors and hindrance IS use stressors influence routine use and innovative use, we set up our study following the needs of the model. A pure quantitative approach based on SEM cannot deliver the necessary insights on the role of hindrance IS use stressors. Therefore, we chose to combine and expand the results with a QCA approach and to complement our theoretical findings with insights from practitioners' perspective adding more richness to our understanding. The sample selection for all three studies is appropriate and large enough (Collins et al. 2006; Marx 2006). The measurement items that serve as input for the SEM and QCA analysis have been either based on prior research or validated with Q-sorting (see Appendix A). The interview data is representative for offering practical insights and while conducting the interviews we have been sensitive to the principles of flexibility, non-direction, specificity and range (Sarker et al. 2018). The overall reliability and validity of the measurement model is granted and there is no evidence for a common method bias (see Appendix B). The QCA results are robust to changes in the used thresholds and the applied calibration process (see Appendix D). We have

recorded and transcribed the interviews following recommendations (Myers 2009). The analysis has been done iteratively with two co-authors until we reached theoretical saturation. The interrater reliability was 0.91 indicating a strong reliability and plausibility of results.

Explanation quality. The SEM results are largely consistent with what we expected based on prior research. Further, those results were plausible and of high practical value, as attested by the qualitative study. The QCA results offer complementary knowledge on the role of hindrance IS use stressors and shed light on causal asymmetry and equifinality of results (Misangyi et al. 2017), from where we can understand the underlying reasons for the SEM results better. We integrated all types of inferences to come up with a holistic theorization of how challenge IS use stressors and hindrance IS use stressors influence routine use and innovative use. The theorization is transferable to other stress contexts and was only possible through the combination of multiple methods. Therefore, the combination of methods was necessary to overcome methodological barriers and offer rich insights into how challenge IS use stressors and hindrance IS use stressors influence routine use and innovative use.

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